Overcoming the Novelty Effect in Online Gamified Learning Systems: An Empirical Evaluation of Learner Engagement and Performance

Abstract

Learners in the Higher Education context who engage with computer-based gamified learning systems often experience the novelty effect: a pattern of high activity during the gamified system's introduction followed by a drop in activity a few weeks later, once its novelty has worn off. We applied a two-tiered motivational, online gamified learning system over two years, and used three-years' worth of longitudinal data to assess students' engagement and performance in that period. Quantitative results suggest that students engaged and performed better in the gamified condition vis-à-vis the non-gamified. Likewise, they sustained engagement better in the second year compared to the first year of the gamified condition. Our qualitative data suggests that students in the second year of the gamified delivery exhibited sustained engagement, bypassing the novelty effect. Thus, we suggest that sustained engagement with computer-based gamified learning systems beyond the novelty effect relies in making the engagement meaningful and useful for the students.

Keywords: novelty effect, gamification, student engagement, computer-based learning system, meaningful

1. Introduction

Educational practitioners advocate harnessing the power of technology for student engagement (Alavi & Leidner, 2001; Chen, 2014; Dickie & Meier, 2015; Donnelly & Hume, 2015; Gourlay, 2015; Seery, 2015). Virtual Learning Environments (VLEs), such as Blackboard, WebCT, and Moodle, are widely used for facilitating the learning of students in the higher education (HE) sector. Yet, the uninspiring use of VLEs may lead to student disengagement and lack of motivation, affecting students' learning negatively (Means, Toyama, Murphy, Bakia, & Jones, 2009). Many instructors overlook user-specific factors that can facilitate success (Petter, DeLone, & McLean, 2013) in the design of their online learning systems (Hassanzadeh, Kanaani, & Elahi, 2012) and simply augment or replicate traditional classroom processes online leading to disengagement Revere and Kovach (2011). Meanwhile, student engagement with lectures, and participation in seminars has been declining in the recent years (Holmes, 2015; Soilemetzidis, Bennett, Buckley, Hillman, & Stoakes, 2014). In a VLE,

the expectation is that students proactively engage with content. However, to make VLEs more engaging, research has argued for better integration among digital strategies, learning science and relevant contextual factors (McKnight et al., 2016).

Educational gamification, which is the application of game mechanics and elements in an educational context, can be the means of offering a user-centered, autonomous, and flexible learning environment (Deterding, Dixon, Khaled, & Nacke, 2011). A gamified learning system can encourage learners to pursue their own goals (Richard N. Landers & Callan, 2011) and engage in deeper-level activities persistently (A. Anderson, Huttenlocher, Kleinberg, & Leskovec, 2014). Gamification seems to be effective in other sectors such as finance, marketing, economical areas, yet it was not originally designed to be applied in an educational context (Zichermann & Cunningham, 2011). Motivation-inducing mechanisms of a typical gamified system include challenges, time restrictions, feedback, virtual status, and when used well they can engage the learners and alter their motivational state as a result of user-user and user-system interactions. This psychological engagement is characterized by a blend of feelings of competence, autonomy and relatedness (Deci & Ryan, 2012). Such psychological engagement can serve as a precursor to behavioral engagement in online learning activities and class exercises, which may result in improved performance (Richard N. Landers & Callan, 2011; Su & Cheng, 2015).

Yet, gamified learning systems have limitations. First, they have been criticized for their addictive, pattern-based methods, and for failing to afford gaming experience (Deterding et al., 2011; Nicholson, 2012; Robertson, 2010). Second, they have not been researched in-depth and thus and thus we lack iterative prototyping for system ideation (Deterding, 2015). Third, user characteristics and needs/preferences are underexplored (Hamari, Koivisto, & Sarsa, 2014); there are exceptions (Davis, Sridharan, Koepke, Singh, & Boiko, 2018) but in general system designers assume that users' characteristics may follow gamer typologies (for example: Bartle, 1996), which are imaginary personae rather than data-driven profiles (Deterding, 2015). Finally, a salient issue with gamified systems is the distinct possibility that they may not be able to sustain learners' individual interests and engagement over a long period of time (Davis et al., 2018; Rodríguez Aflecht et al., 2018), a phenomenon that we have labeled here as the novelty effect (Clark, 1983). This novelty effect is documented in a range of literature, such as in introduction of novel technology, as well as gamification (Hamari et al., 2014) and refers to the tendency for human engagement and/or performance to initially improve during the

introduction of a novel phenomenon, for example, a new technology. In non-game contexts, introducing gamification usually results in a perceived increase in enjoyment as mundane tasks are now "playful". Subsequently, user interest and engagement may gradually disappear once game elements and mechanics are no longer keeping users entertained or satisfied, a phenomenon known as the "hedonic treadmill (Brickman & D., 1971)". The novelty effect is particularly relevant in the context of Computer-assisted learning whenever there is a new computer-based learning system implemented.

In this paper we developed a gamified learning system that adopted a longitudinal iterative design cycle to enhance engagement of students within a unique context (a UK University with a widening participation agenda). Based on quantitative data collected from the university's VLE and portal, we found that student engagement and performance indeed improved as a result of the gamification intervention for two consecutive years. Qualitative feedback suggested that gamification elements facilitated the development of learner extrinsic and intrinsic motivations to engage in learning activities, playing an important role in sustaining students' attention and efforts to transcend the barrier of the novelty effect. Also, with the refinement of the gamified course design, student engagement in the VLE in the second year improved, compared to that in the first year. These findings have direct implications for designers of gamified systems and the educators who use them as well as VLE systems' developers.

2. Theoretical background

2.1. The science of gamification

Gamification, defined as using game design and game thinking in non-game contexts (Deterding et al., 2011), is conceptually akin to *game design*, not to *games*. Gamification research focuses on how the designer's intentions and implementation choices lead to a specific change in target outcomes, such as increased learning, health, civic engagement, or job performance. Landers et al. (2018) depict clear theoretical causal relationships between constructs in gamification science where a wide range of predictors, including game dynamics (such as goals, competition and cooperation, freedom to fail, and many others) and game mechanics (e.g. avatars, badges, boss fights, content unlocking and others), alter users' psychological states (mediators), which consequently influence behavioral outcomes such as engagement or performance in learning activities. The causal pathway from gamification elements to desired outcomes is moderated by a number of design-relevant and design-

irrelevant personal and contextual factors (Richard N Landers, Auer, Collmus, & Armstrong, 2018). This view has been echoed by other researchers (Hamari et al., 2014; Rodríguez Aflecht et al., 2018; Seaborn & Fels, 2015). For example, Hamari et al. (2014) mentioned that *the design/nature of the system*, the *user qualities*, and *the social environment* are all contextual factors that influence the effectiveness of educational gamification.

2.2. Gamification, engagement, and the learning journey

Student engagement with a gamified learning system can be viewed as a journey that consists of discovery, on-boarding, engaging, and end game (Conejo, 2014). Most gamification studies (e.g. (Banfield & Wilkerson, 2014; Barata, Gama, Jorge, & Gonçalves, 2013; Cruz & Penley, 2014; Dicheva, Dichev, Agre, & Angelova, 2015; Hamari et al., 2014; Hanus & Fox, 2015) agree that there is a range of game components that can provide motivational affordances to users. Self-Determination Theory (SDT) (Deci and Ryan (2002) can serve as a theoretical framework to explain how gamification elements influence user psychological (and behavior) engagement.

SDT focuses on the degree to which an individual's behavior is self-motivated and self-determined and suggests that there are different kinds of motivation along a continuum. *Amotivation* lies in the lower-end of the continuum and applies when individuals act passively or do not have the intention to act. The next along the continuum is *external regulation*, which means that people act only to obtain rewards or avoid punishment. The next is *introjected regulation*, which is a regulation of behavior that is contingently based on self-esteem or guilt. Then *identified regulation* means that individuals perform an activity because they identify with its value or meaning and think it's personally important to them. The next is *integrated regulation.* It is the form of extrinsic motivation that is most fully internalized and hence is said to be autonomous, as individuals identify with the value of an activity to the point that it becomes their sense of self. While external, introjected, identified, and integrated regulation belong to what Deci and Ryan (2002) called extrinsic motivation, intrinsic motivation refers to doing an activity for its own sake because individuals find the activity inherently interesting and satisfying.

According to SDT, identification, integration and intrinsic motivation are self-determined motivations, whereas amotivation, external regulation, and introjection are viewed as non-

self-determined motivations. While some game mechanics (e.g., badges, points, levels, or virtual goods), often act as external rewards, other game mechanics (e.g., social graphs, teams, or content unlocking), when used well in challenge-embedded learning activities, may serve as intrinsic motivators to students who imbue these mechanics with personally important meanings (Banfield & Wilkerson, 2014). A well-designed gamification system can be efficient in on-boarding users, i.e. leveraging the desire of users to get on board with the game for potentially extrinsic reasons, such as situational interest (Rodríguez‐Aflecht et al., 2018) or the gaming mechanics utilized by the system such as obtaining status and sharing accomplishments (Conley & Donaldson, 2015). As the learning continues and the learners develop a sense of autonomy, competence, and/or (social) relatedness, they may develop intrinsic motivations. Therefore, if the gamified system enables the learners to transcend the external motivators and develop intrinsic motivators it can trigger a longer-term and deeper engagement among learners (Nicholson, 2012). In other words, we argue that in the application of an intelligently designed gamified learning system there should be a sequence of activities that aims to retain the learners' interest longer than in a non-gamified learning system by using the powerful mechanics of the gamified learning journey. Within the system the learners should move seamlessly from extrinsically sourced motivations to more intrinsic motivations. Therefore, we propose that

> *Hypothesis 1: Student online engagement in a VLE system is higher in the gamified condition than in a non-gamified condition.*

Since the effectiveness of gamification is context-dependent (Hamari et al., 2014; Seaborn & Fels, 2015), we agree with Biesta (2015) who suggested that in an educational context, effectiveness should be linked to learning outcomes. In other words, we must question the effectiveness of gamification not only in terms of 'what works for online learning engagement' but also 'what is the best way to align online engagement with desirable learning outcomes in consideration of students' choices'. We believe that as learners engage longer in the gamified learning system, their intrinsic motivations would sustain long-term and deeper engagement in learning, and therefore they are more like to achieve desired learning outcomes. We thereby propose:

> *Hypothesis 2a: Student online engagement in the gamified VLE is positively related to student academic performance.*

Hypothesis 2b: Student performance in the gamified condition is higher than that in the non-gamified condition.

However, even when the design elements of the gamified system are well established, a notable phenomenon in gamified systems that we labelled the "novelty effect" would affect users' levels of engagement once a system is implemented. The novelty effect, as conceptually illustrated by Hamari et al. (2014) and empirically evident in other studies (de-Marcos, Garcia-Lopez, & Garcia-Cabot, 2016; Hamari & Koivisto, 2015a; Hanus & Fox, 2015) purports that gamification design may be able to change user behavior temporarily as users become curious about the gamified learning systems and want to try them. However, once the novelty wears off, the observed behavioral changes diminish. If the observed positive effects of gamification are attributed to the novelty effect, continued exposure to the gamified system would transform the novel experience into the mundane, thus removing from users the initial excitement to the experience of the novel phenomenon (Clark, 1983). Consequently, learners would end up being turned off by the gamified system, resulting in the opposite of what the gamified system was implemented for (van Roy & Zaman, 2015). The current literature does not explicitly inform designers of the impact the novelty effect may have on gamified systems. The decrease in engagement can be severe if the system designers have a poor understanding in how to design the game elements, resulting in a poor user experience. To address the negative consequences of the novelty effect, games use a variety of mechanics, including unlockable characters, a new dungeon to explore, levelling up and learning new skill. Despite the recognition of the novelty effect in the literature, there is limited research whether the novelty effect exists in every gamified system, how long it may persist, and what are the ways designers may overcome its impact and maintain user engagement (Hamari & Koivisto, 2015b). The novelty effect may in fact, be a factor influencing the sudden increase in engagement and enjoyment of users testing out new features or techniques when using gamification, especially those studies that are conducted over a short time period. We therefore hypothesise that

Hypothesis 3a: The novelty effect influences student engagement in a way that causes engagement to decline across time.

2.3. Design based research approach to gamification

In our study, the design of the first iteration of the online gamified learning system was based on a framework proposed by Werbach & Hunter (2015), which includes six steps: 1) defining system objectives, 2) delineating target behaviors, 3) describing players, 4) devising activity cycles, 5) don't forget the fun, and 6) deploying the appropriate tools. As the first iteration of the gamified system was designed before we experienced the learners' population, we assumed that the user population consisted of a typology of achievers, explorers, socializers, and killers (Bartle, 1996). Assuming SDT holds true we designed learning activities that catered for all types of users while aiming to develop their autonomy, competence, and/or (social) relatedness. To tap into the learners' need for autonomy, learners had freedom to choose what, when, and where to engage in the gamified learning system. To give learners a sense of competence (Deci & Ryan, 2002), common extrinsic gamification tools such as badges and leaderboards were used to reward achievement. To give learners a sense of relatedness (Deci & Ryan, 2002) and social engagement, tasks were designed to allow them to co-create knowledge as well as to provide opportunities for individuality (Wood & Reiners, 2012) using tools such as Wikis and Forum (authors' reference to be added). The VLE provided the space to deploy such gamification tools in addition to the institutional VLE functionality.

For the second iteration we used data gathered from the first iteration, to redesign the gamified system. Specifically, our data and the literature led us to address a number of prominent critiques. Firstly, gameful methods have been criticized for failing to afford gaming-characteristic experiences (Nicholson, 2012; Deterding, 2011; Robertson, 2010) and lacking in game design pattern choices. We responded to this critique by improving design choices to suit a greater range of learners and by providing a clearer "game" narrative through regular communications. Second, very little formative research has been done and no iterative prototyping for system ideation (Deterding, 2015). To address this issue we collected longitudinal data and asked users for voluntary feedback regarding module contents. We then used that data to identify the most popular learning activities based on the first year data and promote them. At the same time, we removed learning activities that were not perceived useful. Finally, system designers often assume their understanding of users based on gamer types, which are imaginary persona rather than data-driven (Deterding, 2015). We responded to this critique by collecting user information and asking user for voluntary feedback regarding system improvement and activity design throughout the first iteration. Table 1 summarises the critiques from the literature on the gamification design, which are applicable to our first iteration of the gamified system and the implications for improvement in our second iteration.

Insert Table 1 about here

We argue that by addressing the above issues our online gamified learning system should improve, leading to the following hypothesis:

> *Hypothesis 3b: Novelty effect in the second iterative gamified VLE would be lower than that of the first iterative design.*

3. Methods

3.1. Research context

A gamified, online learning system was designed and implemented on the institution's VLE (i.e. Moodle) for two consecutive academic years (2015-17) at a post-1992 university in the United Kingdom. The module targeted was the Personal and Professional Development (PPD) module and its aims are to educate second-year undergraduate learners about Business Communication and Research. Our pedagogical objectives were to address two long-standing issues with the module: limited contact hours and low student engagement. Our gamified intervention aimed to alter learners' behavior, and success was defined in two ways: 1) learners getting on board with the learning activities of the gamified system and stay engaged across time and 2) learners achieving improved academic performance. This was one of three PPD modules offered to undergraduate students in the business school to help student employability. The teaching team consisted of twelve tutors, including the module leader. Each tutor was responsible for 12 to 16 students. Topics included values and transferable skills, critical thinking, and other research skills (e.g. conducting small-scale management research).

Despite PPD module aims and objectives being the enhancement of student employability and career capital, most students perceived PPDs as less important modules, compared to other subject-specific ones in their program. To address low student engagement and concerns regarding limited contact hours in the physical classroom environment, a gamified intervention was introduced in 2015. The intervention demonstrated success in student engagement and performance (authors' reference to be added) and therefore improvements in the online learning system were implemented for 2016-17. This learning system is two-tiered: *Essential Learning* (EL) and *Super Learning* (SL). EL activities (ELs) and SL activities (SLs)

were designed with different purposes and were provided over twenty-four weeks across two academic terms in each academic year (term 1: weeks 1-12; term 2: weeks 13-24).

ELs utilized a *flipped classroom* setup and was compulsory. EL activities introduced the students to content covered in the module, utilizing short texts, quizzes, and video clips from the public domain. All ELs were available on Moodle at the beginning of Term 1 but were linked to specific deadlines over the academic year. SL activities pertained to three different levels of difficulty following Bloom's taxonomy (L. W. Anderson, Krathwohl, & Bloom, 2001). They were optional, designed to challenge high ability learners and give them flexibility and autonomy in the learning process (Xu, Wang, & Wang, 2005). In other words, the expectation was that learners who completed SLs would be intrinsically motivated to do so as completing the SLs would not provide any fundamental advantage to the students who chose to do so. Therefore, most SLs (with a few exceptions) were not bound by deadlines.

3.2. Gamification design

There were two gamified online learning system iterations (i.e., design, enactment and analysis and redesign) in this study.

3.2.1. The first iteration.

As part of the gamification system, EL and SL activities were aligned with the module's learning objectives and were presented to learners as challenges within a competitive longitudinal framework. A points-based competition was used as the unifying narrative around which the learners' learning journey was framed and the activities were aligned. Appendix A shows a variety of game design elements used in the EL and SL activities (adapted from Blohm & Leimeister, 2013).

3.2.2. The second iteration

Analyzing data of student engagement and performance in 2015-16 (Author's reference to be added), we were confident that the gamification intervention changed students' behavioral engagement in online learning and consequently, their module performance. However, we were clearly aware that system improvements needed to be made, as summarized in Table 1. Several actions were taken at both system design and implementation stages. First, the first-year student engagement and performance data were used as formative

research for the second iteration. The student user background information collected in the first year suggested that learners from different backgrounds engaged differently (authors' reference to be added) and as a consequence the design pattern choices and learning activities were expanded and diversified in the second iteration to suit preferences of learners from diverse backgrounds (Koivisto & Hamari, 2017). Second, using the principles of user-centered design and student-centered learning approach (Baeten, Kyndt, Struyven, & Dochy, 2010; Gulliksen et al., 2003), we asked learners to give voluntary feedback on their experiences of the gamified VLE. Third, we identified the most and the least popular learning activities from the first-year student engagement data, and then removed learning activities that were not perceived useful and promoted the popular/useful ones. Fourth, we developed a clearer, more playful narrative in the second iteration, to facilitate the on-boarding process of our learners onto the gamified system and a more sustained communication to enhance engagement, aiming to overcome the novelty effect that we felt could have accounted for moderate drops of engagement noticed in the first iteration (authors' reference to be added). Specifically, we informed learners that the optional SLs would help them learn "above and beyond" what was essential. Their completion of SLs would be rewarded with points, badges, and leader board and participation in SLs would enhance the quality of the two summative assessments. We also set a clear goal (Locke & Latham, 1990) for students in the marking criteria by stipulating that EL completion contributes to final grade. For example, learners were told, "for good and excellent engagement, a student needs to complete at least 70% of ELs" as opposed to "Your EL completion is a major part of the engagement." Finally, the module leader instigated regular, weekly communications with students in the second year, highlighting featured SLs and emphasizing the importance of ELs and SLs to their assessments.

3.3. Sample and Data Collection Procedure

The longitudinal data collected from three cohorts were used to evaluate the effectiveness of the gamification intervention and system iterations. We informed learners that data about their background information, online learning engagement and module performance would be collected and analyzed in an aggregated form, to improve the module design. Participation in the computer-based gamified learning system was voluntary and students were provided an opt-out option. Therefore, the sample size on different activities varied from 107 to 165 in

academic year 2015-16, and from 110 to 168 in academic year 2016-17. Quantitative data analyses were conducted using SPSS version 21.0 (IBMCorp., 2012)

As part of the second system iteration, the number of EL activities increased from 14 in 2015-16 to 16 in 2016-17 and the number of SL activities increased from 37 in 2015-16 to 56 in 2016-17 on Moodle. Table 2 summarises the number of students, number of learning activities and assessment types in each year. For meaningful hypothesis testing, we also obtained performance data in the 2014-15 non-gamified PPD2 module for comparison. The details of the performance data are described in the measures section.

Insert Table 2 about here

3.4. Measures

To provide results that will inform the set of hypotheses we have formulated, we have collected both quantitative and qualitative data, the former aiming to assess significance of the results while the latter aiming to understand the qualitative nature of the results. Engagement data were obtained from four modules on Moodle and engagement was measured by multiple "process" and "result" indicators for between-module comparisons and within-module evaluations. The four modules, for which data were collected, included the non-gamified PPD2 2014-15 module, the gamified PPD2 2015-16 and 2016-17 modules, and another non-gamified 2015-16 module (pseudo name "CMC") which was rated as an exemplar module within the business school (in terms of VLE engagement). The "process" engagement was captured by views on a learning activity (an umbrella term that includes any module-related item posted on a module's Moodle site). The "result" engagement was captured by student learning activity completion rate by activity and by week.

3.4.1. Number of EL and SL completion (Aca. Yr 2015-17)

This measure was used for "result" engagement. For engagement in an online learning activity (coded A[*i*]), "1" was coded for an activity completion and "0" was coded for non-completion. Therefore, the number of EL and SL completion for each student was calculated. The date and time of an activity completion was also recorded. Hence, the student learning

activity completion rate both by activity and by week were captured. The descriptive statistics of this are discussed in the results section.

3.4.2. Views on learning activity (Aca. Yr 2014-17)

The term learning activity is used as an umbrella term that includes any module-related item posted on a module's Moodle site. A learning activity can be ranged from a file (e.g., pdf, excel, word, ppt), a folder with files, a URL (more commonly used by modules with traditional ways of delivery and use VLEs as repository) to feedback, assignment, quizzes, forum, and wiki (as designed in the gamified module). We were able to obtain data on Moodle regarding views of each posted learning activity (but not who viewed or when an activity was viewed). Table 3 presented the descriptive statistics of views on the learning activity in each module.

Insert Table 3 about here

3.4.3. Module performance (Aca. Yr 2014-17)

Three years' performance data on PPD2 were obtained for between-module comparisons. The assessments used were the same in academic years 2014-15 and 2015-16 but with minor changes in 2016-17 (see Table 2). In 2015-17, engagement in EL was a major part of the Engagement score. However, engagement in SL did not count towards the final grade classification.

3.4.4. Control variables (Aca. Yr 2015-17).

We included gender (Male = 1; Female = 0), prior performance, and class attendance as control variables to test the relationship between online learning engagement and academic performance. Table 4 summarised gender composition in each cohort. In both cohorts, the sample included was gender-balanced. As to prior performance, we obtained student performance in the Year 1 PPD module (107 data points) for the 15-16 data and accumulated Year 1 GPA (110 data points) for the 16-17 data. Finally, students' class attendance data was obtained from the university's web portal.

Insert Table 4 about here

Table 5 and 6 summarised descriptive statistics for result engagement, academic performance, and class attendance.

Insert Table 5 about here

Insert Table 6 about here

Qualitative feedback (Aca. Yr 2016-17)

We gave a short survey to students in Week 20 in 2016-17. Three questions were asked: "Why did you sometimes not engage in ELs?" "Why did you keep engaging in ELs?" and "Why did you keep engaging in SLs?". Forty-four students provided voluntary responses.

The data were analysed in the following way: (1) student responses were read several times; (2) different descriptions about learning were selected from the data; (3) similar types of descriptions were classified into the same categories; (4) these classes were named, and their contents were reduced; and (5) classes of similar content were included in the same table, and their common meaning was named. This process followed the general principles of an empirical-based content analysis (Patton, 2002) and was inductive by nature. This means that the researchers' reasoning process was directly based on the empirical data.

4. Results

4.1. Process engagement in gamified versus non-gamified conditions

Hypothesis 1 stated that student engagement in the VLE would be higher in the gamified condition than in the other non-gamified condition. We examined engagement using "process" indicators. From Table 3, it is found that in the gamified conditions, not only that there were more learning activities available for students, but also that more learning activities attracted more "traffic" (i.e. student views (see column **(c)** and **(c/b)**). Also, the average view count per learning activity was higher in the gamified modules (352.82 and 290.75 views) than in the non-gamified modules (143.32 and 204.92 views). Moreover, the

view count per activity for an average student in the gamified conditions (2.10 and 1.76 views) was higher than that in the other two non-gamified conditions (0.77 and 1.19 views).

To test Hypothesis 1, one-way ANOVA analyses were performed. In Table 7, there was a significant difference on average views per learning activity (F (298) = 3.74, p = 0.012). Especially, post hoc analyses using the Scheffé post hoc criterion for significance suggested that the average view count per learning activity in 2016-17 (M = 352.72, SD = 445.61) was significantly higher than that in 2014-15 (M = 143.32, SD = 103.86). In addition, there was a significant difference on views per learning activity for an average student (F (298) = 4.05, p = 0.008). Specifically, post hoc analyses suggested that the average view count per learning activity for an average student in 2016-17 (M = 2.10, SD = 2.65) was significantly higher than that in 2014-15 (M = .79, SD = .57). We therefore can reasonably conclude that student online learning engagement was higher in the gamified condition than that in the non-gamified condition. Hypothesis 1 was supported.

Insert Table 7 about here

4.2. Engagement with module & module performance

Hypothesis 2a stated that student online engagement in the gamified VLE is positively related to academic performance. We performed hierarchical regression analyses using the 2015-16 and 2016-17 PPD2 module data respectively. Table 8 and 9 showed that engagement in online learning activities, whether it is EL (Model 2) or SL (Model 3), or both (Model 4), improves student module performance, controlling for gender, class attendance, and prior performance (a prior module, PPD1 performance used in 15-16 data while accumulated GPA used in the 16-17 data). Therefore, Hypothesis 2a was supported.

Insert Table 8 about here

Insert Table 9 about here

Hypothesis 2b stated that student performance in the gamified condition is better than that in the non-gamified condition. To test this hypothesis, we used one-way ANOVA for

between-module comparison, testing the average module performance in two gamified modules (2015-17) and that in the non-gamified one (2014-15) for the same subject across three years. Table 10 showed the differences in mean scores. Using the Scheffé post hoc criterion for significance, we found that there was a significant difference between the module mean score of 14-15 and those of the other two academic years. However, the module mean for 2015-16 was not significantly different from the module mean for 2016-17, meaning student performance did not differ significantly despite the improvements in the gamified system. The results above support Hypothesis 2b.

Insert Table 10 about here

4.3. Comparison of engagement and the impact of novelty effect in the two iterations of the gamified condition

Hypothesis 3a stated that the novelty effect influences student engagement in a way that engagement declines across time. As Figure 1 to 4 only showed whether students completed an EL or SL, it did not show when a student actually completed an activity. The ELs/SLs are introduced in a linear fashion and yet their completion time appears to be unlinked to the order they are introduced. This phenomenon is particularly prominent in the SLs where we see real-time dips and bumps which seem relatively random.

To take time as a parameter into our evaluation of the novelty effect, data recoding is required. Therefore, for each learning activity, we recoded data based on the actual week when a student completed it. Figure 5 and 6 showed the number of EL/SL completion by week in two academic years. From both figures, it seemed that student activity completion started high in both terms (week 1 and 13), decreased gradually, and then went up again towards the end of each term (week 11 and 24).

Regarding the novelty effect, EL completion rate by activity suggested its existence as engagement declined with time. However, it was more difficult to determine the decline in SL completion rate by activity. When the third engagement indicator was used, the novelty effect seemed to be more salient in the 2015-16 data than in the 2016-17 data and more salient in the Term 1 than in Term 2. This seemed to partially support the novelty effect.

Insert Figure 1 about here

Insert Figure 2 about here

Insert Figure 3 about here

Insert Figure 4 about here

Insert Figure 5 about here

Insert Figure 6 about here

Hypothesis 3b stated that the novelty effect would be less prominent or may even disappear in the second iteration of the gamified condition compared to that in the first iterative design. Figure 1 to 4 showed patterns of student engagement in ELs and SLs in PPD2 in two academic years. From Figure 1 and 2, the completion rate for an average EL activity, generally speaking, increased from 53% (87.86/166) in academic year 2015-16 to 78% in 2016-17 (130.76/168). Figure 3 and 4 showed patterns of SL completion rate by activity. The completion rate for an average SL activity, increased from 26% in academic year 2015-16 (34.97/166) to 32% in 2016-17 (49.01/168). The bumps and dips reflected different levels of difficulty in learning tasks. Feedback from students suggested that the SL completion depended on student perceptions of the usefulness of an SL activity.

Regarding to process engagement, the data revealed no significant differences on either average view count per learning activity or average view count per learning activity for an average student between the 2015-16 cohort and the 2016-17 cohort (see Table 11). The results strongly suggest that students' process engagement increased as a result of the online system's improvements, but not at a statistically significant level.

Insert Table 11 about here

With regards to result engagement, because the number of learning activities and number of students were not the same between 2015-16 and 2016-17, we used student completion rate per learning activity as a data point (see Figure 1-4) and conducted an independent

samples t-test on the student completion rate between the 2015-16 and the 2016-17 learning activities. Table 12 showed a significant difference between the 2015-16 cohort and 2016-17 cohort on EL completion rate ($p < .000$), indicating that indeed the improvements resulted in statistically higher engagement. However, differences in the SLs' completion rate between the two cohorts were not significant, indicating that the proportion of students who may be intrinsically motivated remained steady.

Insert Table 12 about here

However, when time of completion is taken into account in figures 5 and 6 it is evident that the decline in engagement is much more salient in the 2015-16 data than in the 2016-17 data and more salient in Term 1 than in Term 2. Overall, it appears that in the second iteration of the online learning system the drops in engagement are nearly non-existent (the only exception being Week 12, the end of Term 1) thus eliminating the impact of the novelty effect. This observation seems to be consistent for both the ELs and to a lesser extent the SLs. The even spread of activity indicates that in the second iteration the system was applied and implemented more successfully and locked the students for longer in the cycle of engagement beyond onboarding and well into engaging and even considering the end-game. Thus, in 2016-17 we witnessed a much more sustained activity. This observation leads to the inference that in addition to the excitement garnered by the gamification elements, other factors may be coming into play to sustain student online learning engagement. Our qualitative data gave certain clues as to why student engagement did not necessarily go down when the novelty wore off in the second year and what led to meaningful gamification which in turn enhanced student engagement. Thus hypothesis 3b is supported.

4.4. What sustained engagement in the VLE learning?

Student process and result engagement in the second year of the gamification intervention was improved and the engagement appears more sustained. The novelty effect all but disappears. As informed by the gamification design literature, the increased engagement was due to the improvements on the gamified system, which addressed a number of game design issues in the second iteration. We collected qualitative feedback from forty-four students from the second iteration of the gamified system at week 20 towards the end of the second term and we asked three questions related to engagement and non-engagement in ELs and

SLs. Our main themes centered around the motivational meanings (Ryan & Connell, 1989) of the students' feedback. After data analysis, a few possible explanations and key points are summarised in Tables 13 and 14.

Insert Table 13 about here

Insert Table 14 about here

While many responses showed that students were extrinsically motivated to engage in both ELs and SLs, the types of extrinsic motivation differed markedly. ELs were viewed as compulsory learning, instrumental to their module performance. Though some students thought SLs were compulsory and instrumental to assessment performance, more students engaged in SLs because of the gamification elements. That is, the gamified motivational learning system provided challenges, rewards, and opportunities to compete with other learners, and that was an attractive extrinsic motivator for students to engage with SLs.

Another remarkable insight from the data related to identified regulation. ELs and SLs seem to have tapped into students' self-valued goals and afforded them with personal importance. Hence they wanted to engage in these learning activities because they wanted to understand the subject, learn new things, and find out if they are right or wrong. To a certain extent, learners were locked into the gamified learning system because of their perceived learning benefits. That is why perceived usefulness was a frequently cited reason for engagement in ELs and SLs (see Tables 13&14). Students found ELs and SLs useful in understanding the module topics and/or refreshing their understanding of key concepts. However, most students reported that the usefulness of ELs is linked to assignment completion (short-term goals) whereas most students perceived SLs useful because SLs completion improved their skills and knowledge development (long-term goals).

Thus it seems that our online gamified learning system achieved considerable sustained engagement in both iterations(!) primarily because it was perceived useful but also because of the triggering of intrinsic motivation via SLs. The motivational affordances from the gamification design clearly affected students' psychological state. The majority of students in SL perceived learning as a challenge, fun and emotionally uplifting.

Figure 7 summarises student responses as to why sometimes students did not engage in ELs. Based on 53 answers provided by 44 students, the two main reasons were commitment to other modules (37.74%), and forgetfulness (18.87%). PPD modules were not perceived as important as other subject-specific modules. Also, the EL completion is a portion of the engagement assessment that is only 10% of the final mark or grade value. Some students may choose to prioritize other learning activities over ELs when being overloaded with module work. The data indicates that for more than half the students, lack of engagement was the result of forgetfulness or commitment to other modules overwhelming the PDP module. It appears that improved engagement with the gamified system in the second year, though not statistically significant enough, may well be linked to the weekly communications by the teaching team rather than any other improvements in the system.

Insert Figure 7 about here
---

5. Discussion

5.1. VLE design implications

While it is assumed that in the digital era, teacher practitioners would be competent in using educational technologies, research shows that general technological competences (e.g., the ability to navigate commonly-used hard- and soft-ware) do not guarantee a competence in effective pedagogical and educational use of technology (Uerz, Volman, & Kral, 2018). McLaughlin (2013) revealed, for example, that there is great variation in Scottish HE academics' use of VLE tools. Most educators would use VLEs for file storage, posting announcements, and delivering learning materials, but would use less VLE reports to track student progress or to engage students in collaborative activities via a discussion board, Wikis or other collaboration tools. Respondents also acknowledged that while VLEs have the potential to enhance the student experience, there is a need to develop expertise in developing VLE systems that enable and realize that potential.

Our research contributes to educational practice and computer-enabled learning by inviting practitioners to reconsider their approach to developing online learning systems. Instead of treating VLEs as file repositories, developing a "game narrative," together with inherent skill-based challenges (Deterding, 2015), can successfully and sustainably deliver meaning in the VLE context and help design an effective learning system that goes beyond

the Novelty Effect. “Meaningful gamification” (Nicholson, 2015) ultimately satisfies learners’ psychological needs of competence, autonomy, and relatedness (Leese, 2009). Evidence that our gamified system successfully provided sustained meaning to engaged learners can be found in both the ELs’ and the SLs’ data. However, the meaning of engagement differed: for students focusing on ELs, it was an instrumental, extrinsically-motivated learning system that helped them do better in the module while for the learners who engaged with SLs the system afforded a different range of motivations beyond the perceived usefulness and instrumentality of the system. For a substantial proportion of the cohort in both iterations, the engagement with the gamified learning system was intrinsically driven and transcended the novelty attraction of a gamified online learning system to become a habitual, playful, game-like activity, thus overcoming the novelty effect (especially in the second iteration).

5.2. Creating meaningful gamification

This study enhances our understanding of gamification research through our quantitative findings, by suggesting the extent to which gamification influences learner engagement. In a gamified learning journey with its implied phases of discovery, onboarding, engaging, and end game (Conejo, 2014), we may conclude that a gamified learning system can help with onboarding users. The number, level of engagement and academic performance of students in the gamified deliveries far outstripped those of the students in the non-gamified deliveries. Learners seem attracted to the unique online learning environment and actively participated in learning activities. However, there seem to be a point of saturation, especially in the case of the first iteration of the gamified system, where once the students got used to the online learning environment and the gamified elements in it, their engagement with ELs in particular wanes, indicating that the novelty effect had an impact. However, in the second iteration of the gamified system we were able to sustain engagement with the ELs even though the gamified system was not mentioned in the qualitative feedback we gathered. It seems that once the novelty of the gamified system wears off (Hamari et al., 2014), common extrinsic motivators of gamification design (e.g. points, badges, and leader board) lose their influence on learner engagement, and were uniformly absent in the qualitative data we obtained with regards to ELs.

The apparent mixed results of gamification effectiveness (Seaborn & Fels, 2015) may be explained when looking deeper into the qualitative data. As suggested by Landers et al.

(2018), the qualitative data confirmed that in addition to the gamification elements, design-irrelevant context factors (e.g. pedagogical factors) contributed to the sustained student engagement. The learners were locked into the system because of its perceived learning benefits. The teaching team's regular communication about the importance of learning activities, the feedback provided to students' submitted work, as well as the quality and relevance of the learning activities to the module's learning outcomes all these qualities enabled students to appreciate benefits of learning. These perceived learning benefits, or meaningfulness, shifted students' regulation from non-self-determined (i.e. extrinsic motivation or introjection) to self-determined (i.e. identification, integration, and intrinsic motivation) (Ryan & Connell, 1989).

Another important point is that the patterns of engagement especially with SLs combined with the qualitative data indicate that this transition was achieved for a portion of the cohort. This pattern of SLs' engagement is consistent in both years implying that the gamified learning system was achieving such a transition from its inception and the second iteration of the gamified system partially improved this transition, converting the gamified system from a novelty gimmick to a "business as usual" learning platform.

Realistically, not every gamified learning system can provide a meaningful, sustained engagement to the students, and therefore we attribute our relative success to an integration of gamified learning design and pedagogical principles to achieve a "meaningful gamification" (McNamara, Jackson, & Graesser, 2010) experience. In the recipe for meaningful gamification, Nicholson (2015) proposed six elements: play, exposition, choice, information, engagement, and reflection. In our gamified learning system, "play" and "choice" were reflected in those optional SL activities were designed to allow for freedom of choice and to facilitate the freedom to explore and the possibilities to fail within safe boundaries. In terms of exposition, a gameful narrative for student learners was created and "the rules of the game" were made clear from the beginning. In addition, the "engagement" element was successfully incorporated as qualitative feedback suggested that students found SLs useful not only for assessment preparation but also for personal development and found that ELs facilitated their learning in the seminar and helped them engage with the sessions. Finally, the "reflection" element was evident as students expressed that both ELs and SLs have contributed to learning improvement. All these elements create conditions for "meaningful gamification" (Nicholson, 2015), which was thought to intrinsically motivate

learners and therefore deepen the long-term engagement and learning experienced by the users.

5.3. Engagement: How It Is Measured Matters

An unexpected insight provides a cautionary note: depending on the way student engagement is measured one can evaluate quite differently the effectiveness of a gamified system. When we originally used "views of a learning activity" as an indicator we found that the "traffic" in gamified modules was higher than that in non-gamified modules (Table 7). However, traffic (visits) does not mean actual engagement in terms of learning activity completion. Then we switched to users' activity completion (rates) as a second, more robust indicator of learning engagement (Figures 1 to 4). Even though this measure showed actual engagement, it did not account for the time dimension, i.e. when a student completed a learning activity. Therefore, a third indicator, number of activities completed by week, was used (Figures 5 and 6) which allowed us to observe the novelty effect (i.e. whether the activity falls after the introduction of the new learning system). We realized that some students engaged in previous weeks' ELs or SLs weeks after the activities were first introduced. This implies that the gamification design that was using the competitive nature (through deadlines) of the learner was not the only determinant of overall engagement (Harviainen, Lainema, & Saarinen, 2014). The self-paced design of the system where learning activities can be taken anytime may also facilitate flexibility and autonomy in learning, and it seems to have encouraged in our case engagement and deeper learning (Deci & Ryan, 2012). This was definitely a salient aspect of our gamified online learning system and a contributor to its success.

EL completion rate by activity (Figures 1 and 2) suggests the existence of a novelty effect as we saw engagement with ELs declining with time. However, it was more difficult to determine the decline in SL completion rate by activity (Figures 3 and 4). Further looking at Figures 5 and 6, we realized that novelty effect was more salient in the first-year gamification intervention and in the first term. Our qualitative data gave certain clues as to why student engagement did not decline when the novelty wore off in the second year as our improved design created the conditions of meaningful gamification which led to a more sustained student engagement.

In summary, our two-year project provided empirical evidence in support of the use of gamified learning systems within a virtual learning environment. Our iterative design did improve the gamified system in the second year and enabled higher levels of student engagement. The increase in learning engagement and performance across both years of the gamified intervention indicates that there was significant success vis-à-vis the non-gamified version of the module and the results of an unrelated yet highly engaging non-gamified business module. The noted improvements between the first and the second year of the gamified system indicated that the main issue resolved was the novelty effect. However, they were not statistically significant as it appears that the first iteration was well-designed and achieved high levels of engagement and performance even though not sustained, with the second iteration only achieving marginal gains and eliminating the novelty effect.

6. Conclusion

In conclusion, the computer-based gamified learning system took learners on board and enabled their learning. Importantly, the gamification elements alone did not sustain engagement although they helped with the discovery and on-boarding of the students. That lack of sustained engagement is often dubbed as the novelty effect and our system was able to overcome it. The online gamified learning system was designed and applied successfully by utilizing pedagogical factors such as the usefulness of learning tasks, clearer expectations, and regular communication and feedback-giving enabling the students to learn and leading to high and sustained levels of engagement. Furthermore, it enabled students to take a learning journey that moved from a state of extrinsic motivation to more intrinsic-like states of being. Our study demonstrates that these pedagogical factors are in line with ingredients of "meaningful gamification." Thus designers of gamified systems and VLEs should implement such context-specific practices that reduce the impact of the novelty effect that gamification designs may have on learners.

Despite the merits of this study, there is an important limitation as we only gamified the computer-based learning aspects of the module and did not consider the offline aspects of the module. Thus our assessment of student engagement may be incomplete. A possible solution to this limitation may be incorporating the offline learning into the narrative of a competition and recording the activities and performance onto the system to achieve a fuller picture of student engagement.

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Appendix A: Figures & Tables

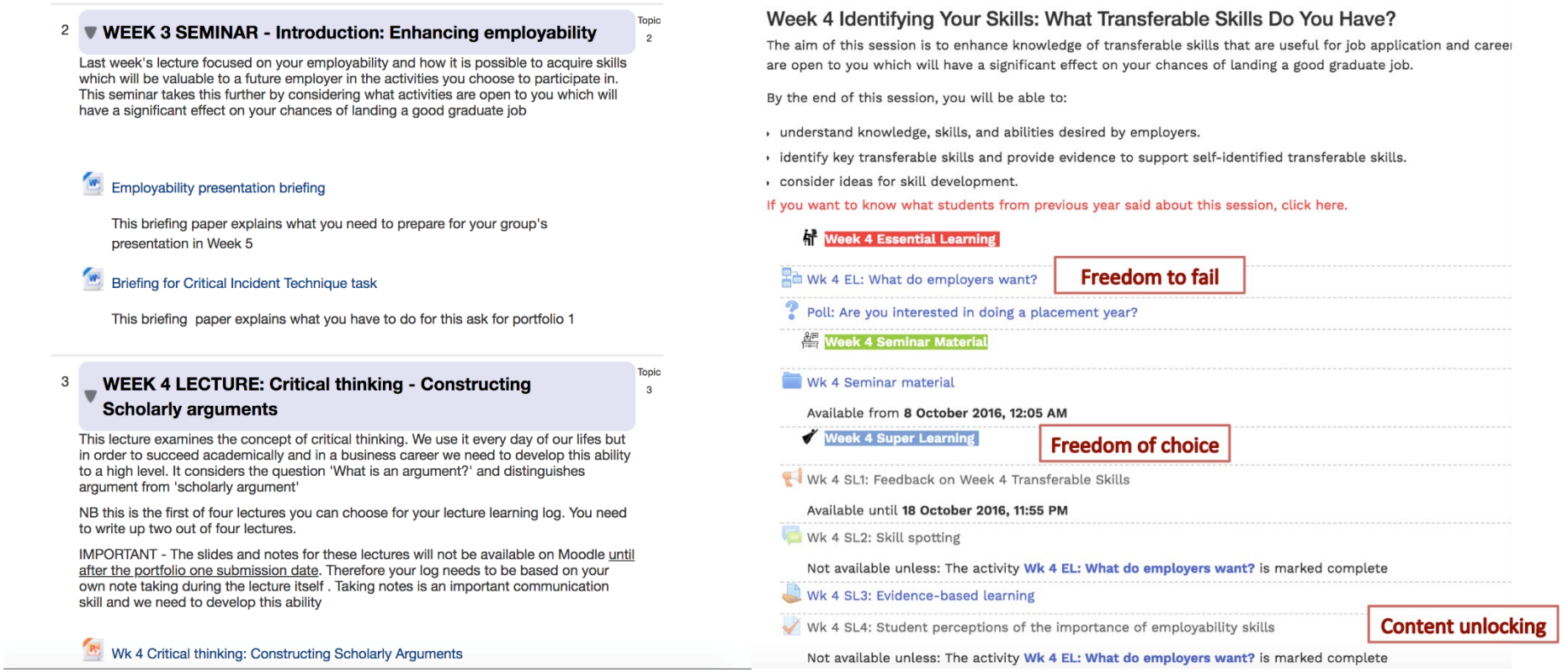


Figure 1. Traditional (left) versus gamified (right) interfaces on Moodle

Wk 6 EL: Thinking like a manager- Underlying assumptions & false premises

Evaluate an argument

Wait a minute. Even though you identified the conclusion and the underlying assumptions. Does it mean the argument is valid? Do we simply accept the reasons (premises) and therefore the conclusion?

As a critical thinker, you know that you need to **evaluate an argument**. You know that the argument is valid only when assumptions are correct.

As to how to evaluate an argument, remind yourself what you remember from last week's video of "understanding arguments" (10:35, optional)

Wk 9 EL: Networking

Networking is about developing and maintaining social relationships, and therefore it enhances one's social capital.

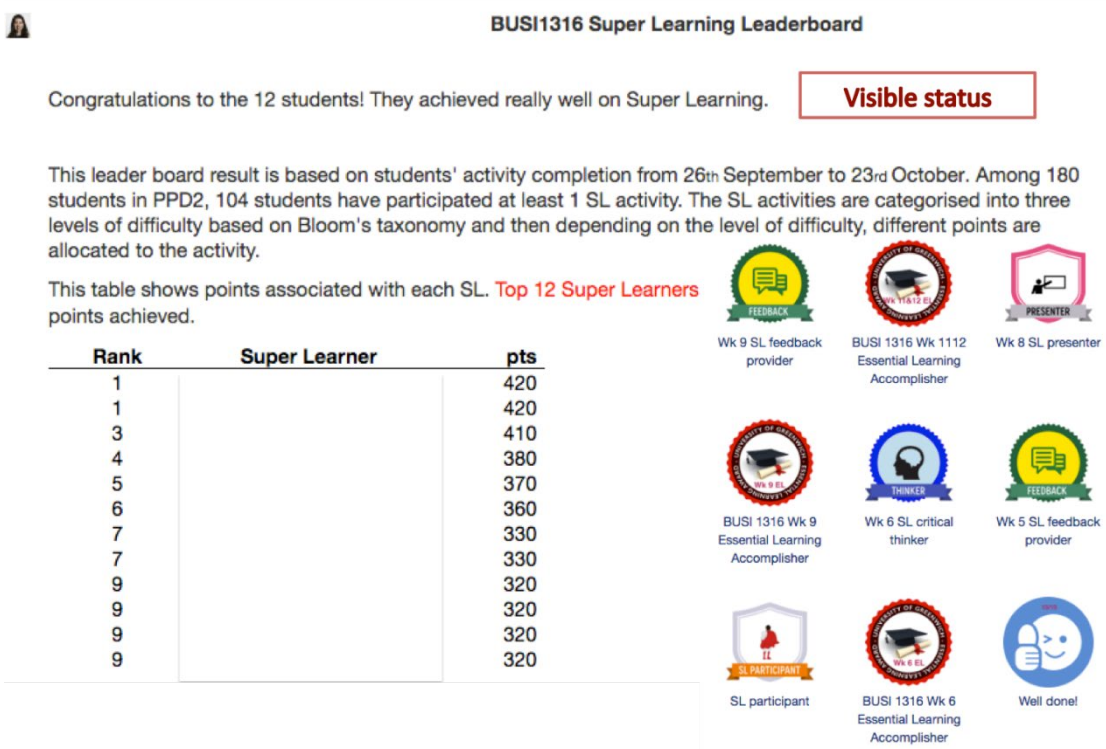
- False
- True

Submit

You have completed 57% of the lesson

57%

Figure 2. Examples of ELs



BUSI1316 Super Learning Leaderboard

Congratulations to the 12 students! They achieved really well on Super Learning. **Visible status**

This leader board result is based on students' activity completion from 26th September to 23rd October. Among 180 students in PPD2, 104 students have participated at least 1 SL activity. The SL activities are categorised into three levels of difficulty based on Bloom's taxonomy and then depending on the level of difficulty, different points are allocated to the activity.

This table shows points associated with each SL. Top 12 Super Learners points achieved.

Rank	Super Learner	pts
1		420
1		420
3		410
4		380
5		370
6		360
7		330
7		330
9		320
9		320
9		320
9		320

Figure 3. SL leaderboard and badges

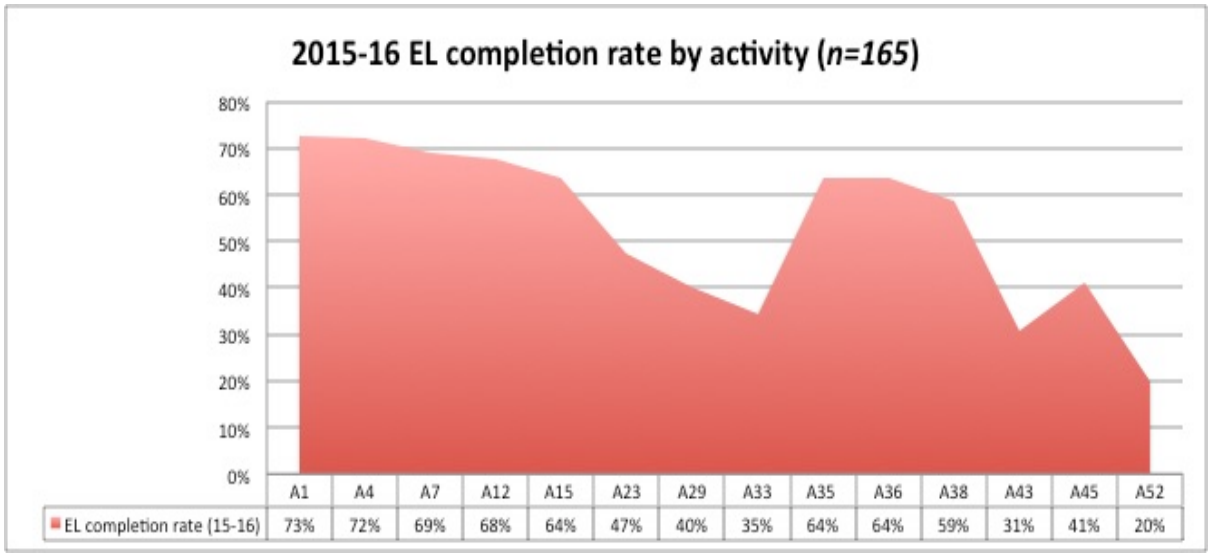


Figure 4. 2015-16 EL completion rate by activity (*n*= 165)

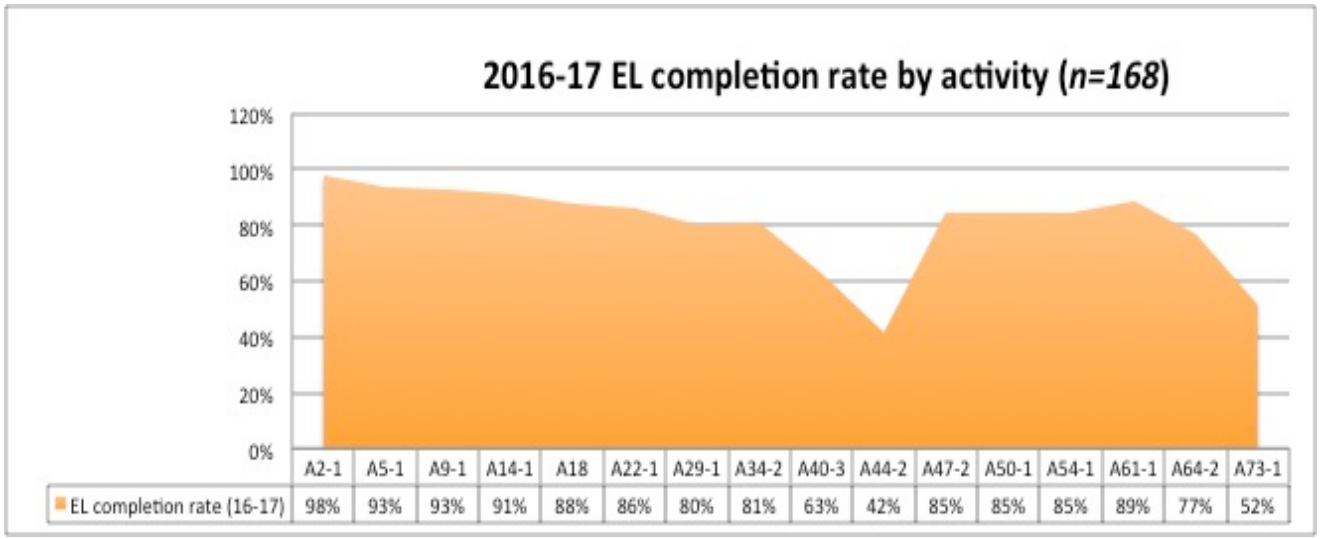


Figure 5. 2016-17 EL completion rate by activity (*n*= 168)

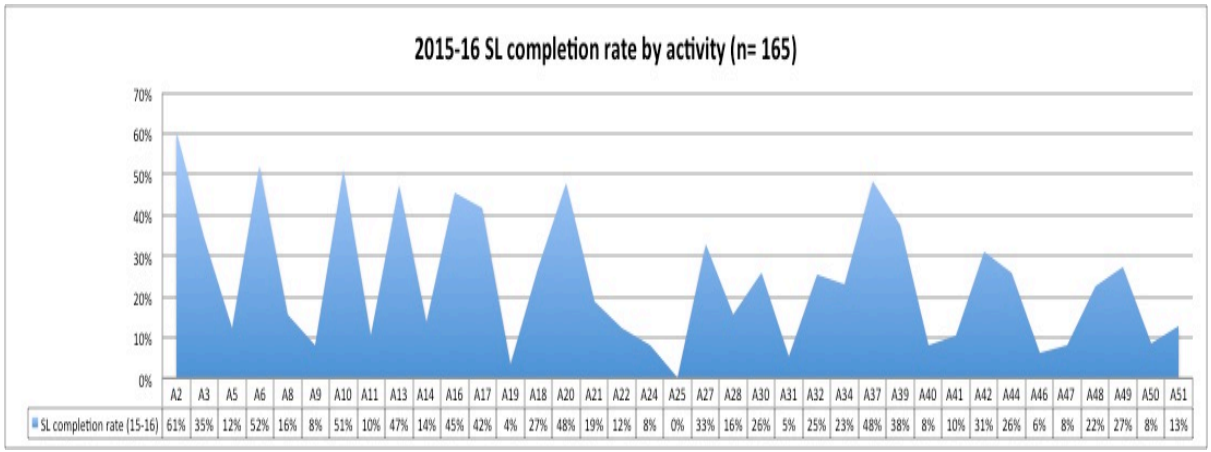


Figure 6. 2015-16 SL completion rate by activity (*n*= 165)

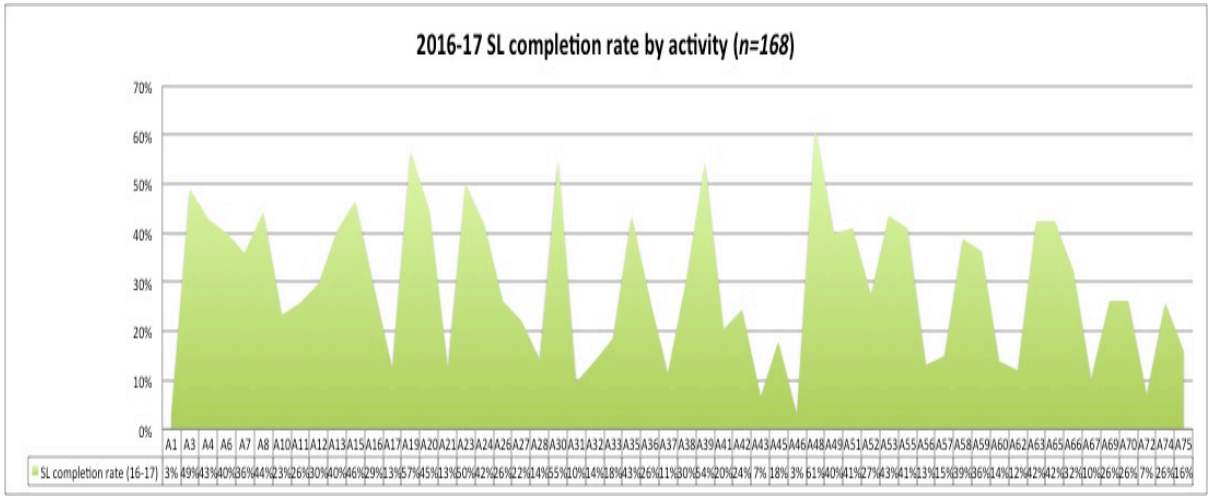


Figure 7. 2016-17 SL completion rate by activity (*n*= 168)

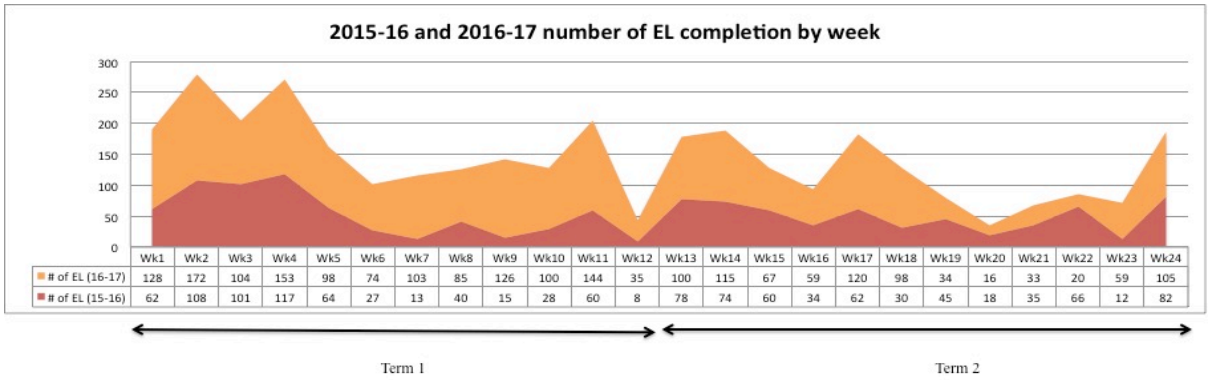


Figure 8. 2015-16 & 2016-17 number of EL completion by week

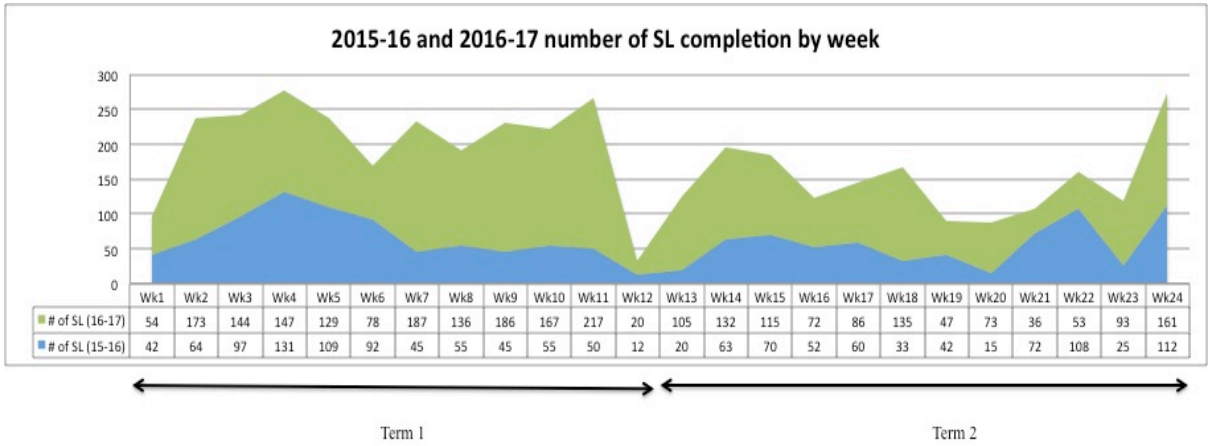


Figure 9. 2015-16 & 2016-17 number of SL completion by week

Table 1.

Critiques and improvement implications on the gamified module design.

Critique on the gamification design	Improvement implications
Lacking guidance in game design pattern choice (Deterding, 2015; Nicholson, 2015; Robertson, 2010)	• Diversify design choices to suit different types of learners • Make the "game" narrative clearer
No iterative prototyping (Deterding, 2015)	• Ask students for voluntary feedback regarding module contents • Identify most popular learning activities based on the first iteration and promoted them in the second iteration • Remove learning activities that are not perceived useful (less engaged) • Regular communication with students
Little formative research & understanding of users (Deterding, 2015; Nicholson, 2015)	• Longitudinal study • Collect user information (demographics, learning motivation) • Ask user for voluntary feedback regarding system improvement and activity design • Regular communication with students

Table 3.
View count based on the learning activity and student number in the gamified modules and the non-gamified modules

Module title	Number of learning activity (a)	Number of students (b)	Total view (c)	View count per activity (c/a)	View count per person (c/b)	View count per activity per person (c/a*b)
Non-gamified PPD (2014-15)	37	181	5303	143.32	29.30	0.77
Non-gamified CMC (2015-16)	36	175	7377	204.92	42.89	1.19
Gamified PPD (2015-16)	87	165	25295	290.75	153.30	1.76
Gamified PPD (2016-17)	139	168	49042	352.82	291.92	2.10

Table 4.

Descriptive statistics for result engagement in 2015-16 and 2016-17

	Mean	Min	Max	SD
2015-16 (*n* = 136)				
No. of EL (14)	8.06	0	14	4.34
No. of SL (37)	9.51	0	34	8.53
No. of EL and SL (51)	17.57	0	48	12.19
2016-17 (*n* = 168)				
No. of EL (16)	12.83	0	16	3.77
No. of SL (56)	16.34	0	52	14.54
No. of EL and SL (72)	29.18	0	68	16.63

Table 5.

Descriptive statistics for assessment types, student performance means and standard deviations

Cohort	Assessment Components	N	Overall Mean	SD
14-15	Portfolio 1 (35%)	175	56.90	13.12
	Portfolio 2 (55%)		58.67	12.07
	Engagement (10%)		64.87	14.54
	Total (100%)		58.67	10.96
15-16	Portfolio 1 (35%)	165	62.06	14.91
	Portfolio 2 (55%)		59.95	17.57
	Engagement (10%)		67.38	18.01
	Total (100%)		61.35	15.01
16-17	Portfolio 1 (45%) + Engagement (5%)	168	59.57	15.29
	Portfolio 2 (45%) + Engagement (5%)		59.23	17.09
	Total (100%)		59.57	14.78

Table 6.

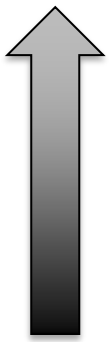
Descriptive statistics for student prior performance and class attendance (n = 110-168).

	Mean	Min	Max	SD
2015-16 (n = 136)				
PPD1 performance[+]	61.52	33	82	11.69
Class attendance	13.54	2	21	4.20
2016-17 (n = 168)				
Accumulated GPA[*]	60.35	0	78.2	9.37
Class attendance	15.4	2	23	4.21

[+] n= 107; [*] n= 110

Table 7

Abstraction of qualitative data towards an SDT motivational affordance



Code	External Regulation
Condensed meaning unit	Students believed that EL engagement help them achieve good grades and receive rewards
Meaning unit	ELs have an impact on my grade For the engagement mark It is essential to engaging marks To get good marks To get better grades Contribute to portfolio grade For Engagement points within the PPD portfolios To maintain my grade To also get a badge to increase my profile

Table 8
Comparison of student process engagement between the gamified and the non-gamified conditions.

	Cohort	N	Mean	SD	Df	*F* value	*p* value
View count per learning activity	Non-gamified PPD (14-15)	37	143.32	103.86			
	Non-gamified CMC (15-16)	36	204.92	170.95			
	Gamified PPD (15-16)	87	290.75	394.37	298	3.74	.012
	Gamified PPD (16-17)	139	352.72	445.61			
View count per learning activity (for an average student)	Non-gamified PPD (14-15)	37	.79	.57			
	Non-gamified CMC (15-16)	36	1.19	.99			
	Gamified PPD (15-16)	87	1.76	2.39	298	4.05	.008
	Gamified PPD (16-17)	139	2.10	2.65			

Table 9.
Summary of regression analysis for variables predicting student performance in 2015-16 (*n* = 107)

Variable	Model 1	Model 2	Model 3	Model 4
Step 1				
Gender	–.17*	–.08	–.12	–.10
Class attendance	.44***	.37***	.39***	.38***
PPD1 performance	.35***	.28***	.31***	.30***
Step 2				
Number of EL completion		.26**		
Number of SL completion			.24**	
Number of EL+SL completion				.27**
F	25.14***	22.78***	23.08***	18.72***
Adjusted R^2	.406	.451	.455	.460
R^2 change		.05**	.05**	.06**

Note: Standardized coefficients are reported for tested variables. *$p < 0.05$; **$p < 0.01$;***$p < 0.001$.

Table 10.
Summary of regression analysis for variables predicting student performance in 2016-17 (*n* = 110)

Variable	Model 1	Model 2	Model 3	Model 4
Step 1				
Gender	-.05	.002	-.01	.001
Class attendance	.48***	.36***	.44***	.41***
Accumulated GPA	.33***	.19***	.31**	.28***
Step 2				
Number of EL completion		.45***		
Number of SL completion			.10**	
Number of EL+SL completion				.25***
F	39.31***	54.55***	32.58***	36.28***
Adjusted R^2	.411	.565	.434	.461
R^2 change		.15***	.026**	.05***

Note: Standardized coefficients are reported for tested variables. *$p < 0.05$; **$p < 0.01$;***$p < 0.001$.

Table 11.
Comparison of student performance between the gamified and the non-gamified PPD modules.

Assessment (%)	Cohort	N	Mean	SD	Df	*F* value	*p* value
Final (100%)	14-15	175	58.67	10.96			
	15-16	160	62.69	10.49	496	6.229	.002
	16-17	162	61.51	10.79			

Table 12
Comparison of student engagement between the first and the second iterative gamified system.

	Cohort	Mean difference (I-J)	*p* value
View count per learning activity	Gamified PPD (16-17) (I) Gamified PPD (15-16) (J)	61.97	.70
View count per learning activity (for an average student)	Gamified PPD (16-17) (I) Gamified PPD (15-16) (J)	.34	.76

Table 13

Comparison of average completion rate per learning activity (result engagement) between two cohorts

Type of Learning	Cohort	*n*	Mean	SD	Df	*t* value	*p* value
EL	15-16	14	.53	.17	26	-.46	.000
	16-17	16	.80	.15			
SL	15-16	37	.24	.16	73	-.161	.112
	16-17	56	.29	.15			